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ABSTRACT

Among students of public health, there is a wide variation of aptitude, preparation, and motivation for the study of biometry. Self-paced instruction offers a way to deal with problems arising from such diversity. The Proctorial System of Instruction (PSI) as described by Keller was used to present two elementary biometry courses. Although there were some difficulties in preparation and administration of the courses, students and instructors agreed that the method is an acceptable alternative to the more usual lecture method. The diversity of student backgrounds is noted and a PSI flow chart is included. (Author/LBH)

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SELF-PACED INSTRUCTION IN BIOMETRY AT THE UNIVERSITY OF TEXAS SCHOOL OF PUBLIC HEALTH

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1. Introduction

Each year about 125 to 150 new students are admitted to The University of Texas School of Public Health. Most of these students enroll in a two-quarter course sequence in introductory biometry. Topics covered include descriptive statistics, elementary probability, sampling, estimation and hypothesis testing.

Typically, the students in these courses vary greatly in their aptitude, preparation and motivation for the study of biometry. In the Fall of 1974, 113 students enrolled in the first course in the sequence. Table 1 presents the distribution of these students with regard to the number of math and physical science courses taken as undergraduates. It is not surprising that the needs of such a diverse group for instruction in biometry might be difficult to meet.

2. The Proctorial System of Instruction

A little more than ten years ago, Fred Keller, then a psychology professor at Princeton, began to suggest that college courses could be presented in a manner that would take greater advantage

of certain well-known facts of human behavior than the traditional lecture methods. He sought to introduce more extensive use of positive reinforcement for students as they completed a succession of carefully designed tasks leading to an overall goal. All information was communicated in written form so that lectures addressed to a class whose individual members might be either bored or bewildered were no longer needed. Progress through the written material was determined by frequent short exams, administered by a proctor (hence the name Proctorial System of Instruction, or PSI) and checked and discussed immediately after completion. Positive reinforcement was supplied by success in passing the exam and in the progress toward the goal of completing the course.

Since lectures were no longer needed, time constraints required by the lecture method could be discarded. Progress in course was defined in terms of units of work completed rather than by the passage of time. Students were allowed to take more or less time to complete the course, depending on their individual needs or abilities.

Keller[1] describes the distinguishing features of the method in a much-quoted summary:

(1) The go-at-your-own-pace feature, which permits a student to move through the course at a speed commensurate with

his ability and other demands upon his time.

(2) The unit-perfection requirement for advance, which lets the students go ahead to new material only after demonstrating mastery of that which preceded.

(3) The use of lectures and demonstrations as vehicles of motivation, rather than sources of critical information.

(4) The related stress upon the written word in teacher-student communication; and finally:

(5) The use of proctors, which permits repeated testing, immediate scoring, almost unavoidable tutoring, and a marked enhancement of the personal-social aspect of the educational process.

The proctorial system of instruction with its emphasis on self-pacing seemed to offer some promise as a means of dealing with the diverse needs of our students. Several studies [2,3,4] indicated that PSI had been used effectively to teach a variety of topics, including in particular, statistics. We obtained PSI study materials written by Paul Powell and G. B. Wagner for use in an introductory statistics course for mechanical engineers at The University of Texas at Austin. These materials were modified and extended to meet the needs of our students at The University of Texas School of Public Health.

The first of our two introductory courses was divided into ten study units which discuss descriptive statistics, probability, distributions, sampling, life tables and an introduction to computers. The second course was divided into nine units which introduced estimation, testing, regression, analysis of variance and non-parametric statistics. Each study unit was arranged according to the following outline:

1. Reading Assignment

   A few specific paragraphs or pages in the course text or other references.

2. Statement of Objectives

   A list of specific facts or skills to be learned in this unit.

3. Study Hints

   A list of specific hints, comments, problems and questions to help the student understand the reading assignment and relate it to previous units.

4. Supplementary Problems

   A set of problems similar to those on the unit exam to allow the student to determine his readiness for the unit exam; also to further pursue topics mentioned in the text or to develop additional topics.

5. Answers to Selected Questions From the Study Units

   Complete solutions with comments for most of the questions.

6. Answers to Supplementary Problems

   Complete solutions with comments.

7. Applications to Public Health

   Excerpts from journal articles, theses, reports, texts or other sources illustrating the application of the topics discussed in the unit.

At the first and only class meeting, the students were given Study Unit 0 which contained this explanation of the procedure to be followed:

> "After you receive Unit 0, study it at your own pace, and, when you are ready, go to the examination room during the hours indicated below and ask a proctor for an exam on Unit 0. He will give you a prepared exam consisting of questions based directly on the material in Unit 0. Take this exam and the paper which will be supplied to the testing area and answer the questions without the aid of your notes or text.
>
> "When you have finished, return the exam and your answers to the proctor, who will then grade it immediately.

In order to pass the exam, you must answer all the questions correctly.

"If you should not pass the unit test, no harm will have been done. Simply study the assignment again and take a different form of the exam over the same material. If you should fail four tests on a given unit, make an appointment with the instructor to discuss the reasons for your difficulty and to take an oral exam over the unit's material. If you fail the oral exam you may be asked to drop the course and to try again later.

"When you pass the exam for one unit you will be given the next study unit. This process will be repeated until you have successfully completed Study Unit X. At that time you will have completed and passed the course."

The essential points of this procedure are summarized in the flow chart given in Figure 1.

The proctors were students who had passed both introductory biometry courses and demonstrated a mastery of the material or else students who were majoring in Biometry. The proctors had the responsibility of giving out and grading the unit tests, clarifying problems found by the unit tests, and answering questions on the study units.

3. Evaluation of PSI

Since the effectiveness of PSI had been established to our satisfaction, we were interested in the acceptability of PSI as an alternative to the lecture method to both students and instructors in public health. Therefore upon completion of each of the PSI courses or at the end of the Spring Quarter, students were asked to give their opinion of the course by completing a questionnaire indicating disagreement, neutrality, or agreement with each of several statements. These statements and responses are recorded in Table 2; the modal responses are underlined.

These responses seem to indicate that the students generally perceived the course as beneficial and would be willing to participate in such courses again. Several other questions, mostly dealing with more specific details of the course were asked and the responses were in harmony with these general observations.

The overall sentiments of the faculty and proctors concerning the utility of the PSI technique seem to echo those of the students. However, several points concerning our experiences with the administration of the PSI bear consideration: (1) while the go-at-your-own-pace feature is of major benefit to the student, it can also mean an extension in the amount of time normally allotted for a course (e.g. while the two elementary biometry courses take two quarters by the lecture method, many of our students used three quarters

for the same credits), (2) since each student is operating as an individual, an extensive and well maintained set of records is essential for following student progress (this can be a large administrative burden in comparison to more traditional techniques), and (3) the close, one-on-one nature of the PSI encounter affords the student more opportunity for discussion and questions--this means more time devoted by faculty and proctors to answering questions than one would expect in a more traditional approach. While each of the above points can be seen to represent an added burden for those involved in teaching the course, we would emphasize that each is also a direct result of an important benefit realized by the student. We feel the benefit justifies the burden.

4. Summary and Conclusions

Our experience with PSI may be summarized as follows:

1. It is an effective method of teaching elementary biometry. Since progress is determined by performance rather than by time, we are more confident of our graduates' knowledge than with the lecture method.
2. Student reaction was generally favorable. Most students would agree to take another PSI course.
3. PSI requires a great amount of time and effort from the instructor. Preparation of materials and administration,

particularly the first time the course is offered, can be major projects. Presumably this would moderate as the course is repeated.

4. An additional benefit was the noticeable increase in skill and confidence of the student proctors. We would recommend this experience for students interested in biometry.

5. The flexibility of scheduling is a major advantage to students. Personal problems, such as sickness, travel, and special projects can be accommodated as well as allowing for individual variations in the rate of progress. This also presents interesting possibilities for continuing education or on-the-job training of health workers.

Our experience with PSI was demanding, but rewarding. We feel that it is worthy of serious consideration as a method of teaching elementary biometry.

Figure 1. Biometry I PSI Flow Chart

Table 1. Distribution of Biometry Students with Regard to Number of Undergraduate Math and Physical Science Courses

Table 2. Student Evaluation of PSI: Biometry I and Biometry II (Entries are Percent of 94 Responses; Modal Responses are Underlined)

Figure 1. Biometry I PSI Flow Chart

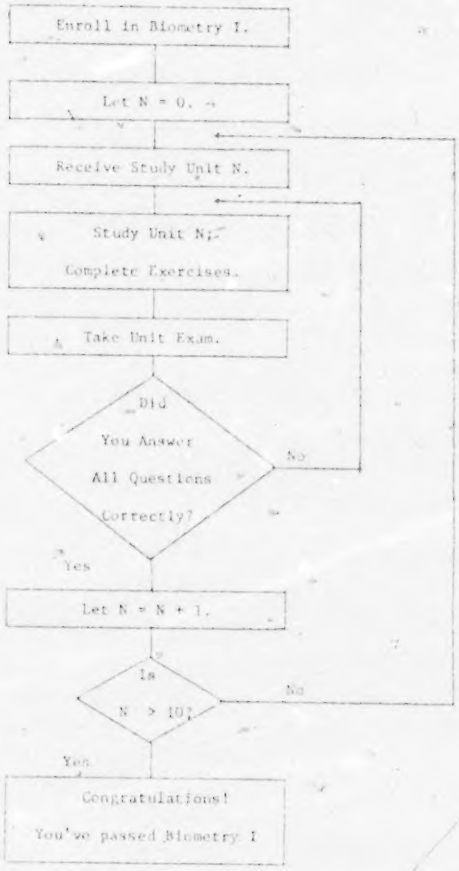

Table 1. Distribution of Biometry Students with Regard to Number of Undergraduate Math and Physical Science Courses

Biometry Students	6	30	25	34	18
Number of Math and Physical Science Courses	0	1- 4	5- 9	10-14	15+

Table 2 Student Evaluation of PSI: Biometry I and Biometry II

(Entries are Percent of 94 Responses;

Modal Responses are Underlined)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. The study guides and reading material were not an adequate substitute for lectures.	29	<u>45</u>	11	12	3
2. I object to being graded by proctors who are students.	<u>54</u>	42	3	1	0
3. Knowing the results of an examination after each unit was very beneficial.	0	1	4	32	<u>63</u>
4. The arithmetic and algebra used in this course were major sources of difficulty for me.	25	<u>44</u>	10	17	4
5. The amount of material I learned in this course was greater than in most courses I have taken.	1	7	30	<u>38</u>	23
6. I retained more material in this course than in other more traditional courses I have taken.	5	14	31	<u>39</u>	11
7. There is no reason why the PSI format could not be applied to other courses.	4	4	13	<u>43</u>	36
8. I would like to take other courses that use the PSI format.	4	9	12	<u>42</u>	34

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